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REVIEW OF INTERNATIONAL EXPERIENCE ON INCLUSION INTO TARIFF SETTING OF QUALITY OF SERVICES INDICATORS AND OTHER SPECIAL ISSUES IN WATER & WASTEWATER AND DISTRICT HEATING SECTORS

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REPORT

Review of international experience on inclusion into tariff setting of quality of services indicators and other special issues in water & wastewater and district heating sectors

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Executive summary

1. The Report provides overview of regulatory practice on quality assessment and inclusion of it into incentives regulatory package in the domain of municipal services. Also, Report provides examples on certain arbitrary types of costs that shall be of interest while developing final approaches of incentive based regulatory model for Ukraine. The Report analyzes pieces of regulatory practice from Bulgaria, Estonia, France, Latvia, Lithuania, Poland, Portugal, United Kingdom. It has to be noted, that some countries choose their way to regulate technical part of quality centrally and operations of utilities not to regulated centrally – as, for eg., water case in Denmark – voluntary benchmarking in the industry is conducted over more than decade years, and became compulsory just recently. Norway, Finland, Sweden too, have their voluntary benchmarking systems operated by industrial bodies.
2. The first general observation is that **quality as regulatory dimension is in practice very much interrelated with operational efficiency**, and sometimes these two are **used interchangeably**, i.e. without separating quality as unique component in the incentive based regulatory "formula", but rather automatically using as an inherent element of efficiency. In some cases it is reasonable, for example, reduction in network losses mean in parallel better operational efficiency (reduced costs of service unit), but also it means better quality in environmental terms.
3. The quality indicators for municipal services fall into **three categories** – **product quality indicators** (for eg., water biological purity), **operational quality indicators** (eg., accessibility of network services), **consumer care quality indicators** (eg., timely investigated complaints). Regulators not in every case establish all the indicators, but rather decisions of other public bodies are present, which quality indicators are important and have to be met.
4. As a consequence of multi-institutional collaboration, **variety of monitored quality indicators is greater that the number of quality indicators actually falling under incentive based regulation**. Incentive regulation covers limited amount of quality indicators, and a tendency of limiting the number of quality indicators under regulatory schemas is observed.
5. The monitored quality indicators **serve for market transparency** and self-regulatory initiatives, in those cases when they are not used for incentive based regulatory formula.
6. Menu of Water quality indicators looks more developed than the variety of District heating quality indicators, most probably due to the fact that water regulation is global initiative, and district

heating regulation is more regionally concentrated. As for district heating, the Report provides menu of possible quality indicators, that are suggested by research bodies and that can easily be implemented into regulatory practice.

7. As for practical purposes of regulatory activities in the area, it is advisable to consider the option of **establishing a wider package of quality indicators that shall be used for market monitoring and market transparency purposes**, and **additionally depicting a set of manageable number of quality indicators** that shall be **used for incentive regulation purposes to set regulatory revenue** / tariff. The relatively small set of quality indicators for "active" regulatory usage is to reflect the key positions or key areas which call for quality improvement.
8. The two sets of quality indicators shall serve two regulatory impact areas – first, efforts for better quality via virtual competition through market transparency ("passive" regulation) and second, direct pressure through regulated revenue and establishment of incentives ("active" regulation).

Overview of quality concept for municipal services

9. Partial schemes to promote cost saving, investment efficiency, and service quality are possible and used by regulators in post-reform regulation, starting with electricity networks back in 90's[1].
10. Relationship between quality performance and incentive based regulation in general has attracted some of studies in different regulated sectors[2], however a number so far is not so great[3]. The studies present indicate, that there is relationship between incentives based regulation and quality state; also studies indicate that incentive regulation affects quality through its impact on operations and maintenance expenses. On the other hand improvements in service quality have made a significant contribution to the sector's total productivity change under regulation[4]. The necessity to link (to pair) quality provisions and incentive based regulation (cost efficiency) is analyzed and proved by researchers, and **integrating quality of service in regulatory practice is preferable to cost-only approaches**. Nevertheless the fact that the majority of studies relate to electricity area, general principles of the matter are applicable to municipal services' area either.
11. The general discussion on the domain of incentive based regulation and quality can be generalized this way: quality of service is important for all customers, however, improving upon a given level of quality of service comes at a cost. At the same time, incentive based regulation schemes provide utilities with strong incentives to undertake cost savings. And thus the contradicting vectors provide a question as to **whether regulated entities respond to cost saving incentives by reducing service quality**, rather than by pursuing real efficiency improvements, and which measures shall be employed by regulator to manage the contradiction.
12. Below, here is presented brief overview of studies and reports as regards quality indicators development and usage in District Heating and Drinking Water Supply and Sewerage sectors. By here, it is worth mentioning the general **requirements** for regulatory quality indicators. The **quality measures** shall be[5] (i) important to consumers, (ii) controllable by entities under regulation, and (iii) measurable by regulators. It is recognized, that consumers' valuation might be inconsistent, context-dependent, influenced by previous experiences and expectations, providing not sufficient information; therefore the consumers shall not the only measuring party.

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[1] Dimitrios Giannakis, University of Chicago, Tooraj Jamasb, Michael Pollitt, University of Cambridge, 2003.
[2] Ter-Martirosyan, Anna. 2003, George Washington University.
[3] Many empirical studies examine the effects of incentive regulation on prices, costs, profits, etc.; out of energy domain, there studies addressing quality impacts of incentive regulation in the electric utility industry.
[4] Dimitrios Giannakis, University of Chicago, Tooraj Jamasb, Michael Pollitt, University of Cambridge, 2003.
[5] Robert, A., 2001, ELIA, Brussels.

The wide array of technical nature quality indicators presented is blended by attitude nature quality indicators, thus way providing grounds to make objective and complex assessment of quality level.

13. The structure of **quality dimensions** to measure is applicable to municipal industries, despite originally used for electricity industry[6]:
    - **Technical quality** (engineering parameters). The service quality dimensions associated with technical quality – or what consumer receives as the outcome of the process - are those that can objectively be measured, regardless of customers' opinion technical quality;
    - **Reliability** (ability of the network to continuously meet demand), as per long term ability to meet changing demand, and as per actual performance on the short run;
    - **Commercial quality** per one-off contacts (connection to network, installment of meters, etc.), per regular contacts (billing, meter reading, etc.), per occasional transactions (responding to problems, complaints, etc.). The service quality dimensions associated with functional or commercial quality – or how the consumer receives the outcome of the process - are related to the interaction between the provider and consumer of the service and are often perceived in a subjective manner.
14. There are some observations that come from general theory of service quality[7] and that are useful to keep in mind while considering regulatory performance quality, especially in the dimension of commercial quality. Corporate image plays the important role in the context of quality - service quality provided by a provider with positive image will be perceived more favorable in comparison to service quality provided by a provider with negative image. The other part of service quality is related to perceptions. Expectations on quality of consumers influence on the Perceived quality of the service received, and this in its turn shapes the Perceived value the consumer attaches to the service received and the overall consumer satisfaction.
15. The **linkage of quality and incentives regulation** can be **established** following several generic approaches[8]. Quality incentives to regulated entities under Incentive based regulation are provided via:

[6] Ajodhia, Dr. Gian Carlo Scarsi, Petrov, K. 2006.
[7] for eg., Christian Gronroos, 1990.
[8] Dimitrios Giannakis, University of Chicago, Tooraj Jamasb, Michael Pollitt, University of Cambridge, 2003, via Frontier Economics, 2003.

- **marginal rewards/penalties**. Entities receive rewards or penalties per unit of quality improvement o degradation, and the amount of reward (penalty) is calibrated to reflect the marginal value to customers;
- **absolute fines attributed to quality**. Regulator requires entities to pay a pre-specified amount if quality drops below an established threshold. Regulator sets both, threshold and amount payable, and consumers are guaranteed with certain standards of performance[9];
- **quality incorporated benchmarking**. This works in similar way as marginal rewards/penalties. Under price cap regulation, an entity that delivers increased quality relative to its peers would be allowed to raise its price by an amount that reflects the social value of the increased quality; underperforming entity would be imposed with corresponding price reduction. It is to be underlined, that this kind of developed quality incentives (a) make pressure on entities to deliver optimal cost and service quality bundle, thus maximizing static gains[10] and static peer-competition, and (b) encourage entities to pursue for dynamic gains[11]. Quality incorporating benchmarking poses challenge of maintaining a balanced financial and quality-oriented incentives for entity.
- Under objectively organized regulatory incentives, entities are indifferent as to whether they have quality incentives at transacting with the government (through fines) or with consumers (through compensation or reduced prices), from economical point of view.

16. Quality incentives, incorporated under price-cap regulation, have the expression as depicted in the formula below:

$$R_{t+1} = R_t * (1 + CPI - X \pm Q) \pm Z$$

where

Q – composite quality indicator, allowing the entity in question gaining additional revenue up to certain percentage if quality measures are met, probably another percentage if quality measures are exceeded and also, penalizing the entity in question with certain percentage of revenue if quality measures are not met[12].

[9] It is recognized that in practice both marginal rewards/penalties and absolute fines can be combined.
[10] Max quality under fixed cost number.
[11] Search & implement long-term investments that shift quality provision costs downwards.
[12] For eg., in UK, the first introduced quality incentives, under so called Information and Incentives Project, provided the following incentives: penalizing up to 1.75% of revenue for not meeting quality of supply target (measured in on KPI) and rewarding with 2% of revenue for exceeding quality of supply target, and a mechanism for rewarding or

17. Quality incentives, if incorporated under rate of return regulation, would result with the following
18. The district heating and drinking water supply and sewerage services (the object of this Report) are called municipal services. However, some points need to be underlined before further analysis is presented:
    - First, the adjective “municipal” specifies the organizational side of the business, first of all, territory of operations, in some cases might indicate ownership structure, wider involvement of public institutions of municipal, level into decision making process. However, in the view of quality indicators settlement and assessment, municipal business shall be regarded as any other business;
    - Second, the noun “services” points that service quality theory (for the purpose of the Report) shall be applied. Nevertheless, the contents of District Heating as well as the contents of District Water Supply and Sewerage entails both product and service, and therefore both business have to be regarded as product and service complex[13]. The applied quality indicators settlement and assessment system is to be able to measure and assess this complexity of product and service.

penalizing companies annually, up to a maximum of 0.125% of revenue, for the relative quality of their telephone response to customers.

[13] As for DH, there might be some cases of pure product purchases, say hot steam for industry purchases, however, in most cases temperature comfort in premises is purchased object from DH entity.
The similar goes to WS business – there might be cases for pure product purchases, say water for SPA resort, but in most cases continuous ability to get water in premises is the purchased object.

Quality indicators for Water Supply and Sewerage sector

19. In Drinking Water Supply and Sewerage sector, in principle, entities are engaged in one of the businesses or in both - Drinking Water Supply business and Sewerage Services businesses.
20. In one of reports, the World Bank defines Water service quality as “hours with water daily” and quality of Sanitation services as “sewerage blockages per connection”[14], as the most illustrative indicators to demonstrate the dynamics of the relevant sector. However, in practical reality these sectors have a greater number of indicators by which quality might be measured and subsequently incentivized.
21. The indicators, which could serve for measurement of service quality in the sector, in major part, have been presented in one of previous Reports, as integral part of all the benchmarked indicator setting, so here it will not be repeated. In addition is needs to be mentioned, that in the sector, as a kind of separate group of indicators, environmental quality and drinking water safety quality issues are of high importance. As regards technical/operational business quality and consumer care quality indicators, these groups are present in water utilities regulation either.
22. Here it will be presented practical examples of water and sewerage service quality indicators at regulatory use.

[14] World Bank, Public Private Infrastructure Advisory Facility, Report “Does Private Sector Participation Improve Performance in Electricity and Water Distribution?” of 2009.

Quality indicators for District Heating sector

23. In District Heating sector, taking its importance towards European 20-20-20 targets, possible role in implementing the agreement of COP21, and its general potential either, enjoyed rather low number attempts to assess heating district networks performance through quality indicators[15]. Nevertheless, attempts to develop quality indicators for district heating operations resulted in a number of indicators proposed by academia and other parties.
24. Here are provided wide range of examples of quality indicators, as proposed for DH sector by researchers, associated organizations, etc., that could effectively to be used for quality measurement of DH activities for regulatory purposes. It has to be noticed, that the variety of indicators "on menu" is significantly greater that the setting used for practical purposes in regulatory domain, which will be disclosed in relevant sections of the Report, below. The choice to provide a wide selection of options is due to the understanding that the quality measurement and inclusion of the results into incentive based regulation practice decisions (revenues, tariffs, etc.) so far is under early development in DH regulatory practice. And the early stage provides basis to make initially reasonable choice of indicators use, out of entire variety proposed *a la carte*.
25. The DH quality indicators fall into three main categories, indicators of technical nature, including reliability, and indicators of attitude or consumer care. First, list of suggested technical quality indicators is provided, and after, suggested consumer attitude quality indicators are provided.
26. The DH quality indicators include[16]:
    - **Primary resource factor**, PRF[17], expresses the ratio of the non-regenerative resource energy required for the building to the final energy supplied to the building. The use of the primary resource factor (PRF) enables to measure the savings and losses occurring from energy generation to the delivery to the building. The primary resource factor represents the energy

[15] P.E. Pacot, S. Reiter, 2011. University of Liège.
[16] On selective basis, here is used information from Euroheat & Power; IGD & AMF (France).
[17] Here is Primary Resource Factor, and another indicator below is provided Primary Energy factor. The difference in those is derived from the difference between resource and energy. Here is how Euroheat&Power state the difference: Primary energy may be resource energy or renewable energy or a combination of both. Resource refers to a source depleted by extraction (e.g. fossil fuels) and renewable energy to a source that is not depleted by extraction (e.g. biomass, solar).

delivery but excludes the renewable energy component of primary energy. The formula for PRF is below[18][19]:

$$f_{DH} = \frac{\sum[Q_{F,i} * f_{P,F,i}] - W_{CHP} * f_{P,elt}}{\sum Q_{C,i}}$$

where

$Q_{F,i}$ - Fuel (final energy) input to the heating plants and to the cogeneration plants within the considered system within the considered period (usually one year). The amount of this energy is measured at the point of delivery;

$f_{P,F,i}$ - Primary resource factor of the fuel (final energy) inputs[20];

W_{CHP} - Electricity production of the cogeneration plants of the considered system;

$f_{P,elt}$ - Primary resource factor of electrical power. This factor is given by the European average - in accordance to principles laid down in annex III of Directive 2004/08/EC;

$Q_{C,i}$ - Heat energy consumption measured at the primary side of the substations of the supplied customers within the period of interest (usually one year).

- **Primary energy factor**, PEF, which quantifies the primary energy use of a district heating network. This quality indicator was originally developed by Euroheat&Power in 2006[21], and proposed a performance assessment of a district heating network. PEF allows to compare in an efficient manner two heating technologies, e.g. district heating network and conventional boiler. PEF is expressed with the formula below[22]:

[18] The original formula proposed by Euroheat&Power.

[19] The application of Primary Resource Factor for comparison purposes of different entities in Italy and Sweden is presented in Annex 1. The data is quite old there, however, the message is that PRF can efficiently be used for comparison purposes, and it serves well to propose insights into quality of relevant systems in question.

[20] The primary energy factor f_p related to energy source is the following:
Lignite coal – 1.30
Hard coal – 1.20
Oil – 1.10
Natural gas – 1.10
Wood, biomass – 0.10
Excess heat, e.g. from industrial processes – 0.05
Geothermal – 0.00
Waste as Fuel, Landfill Gas, Household waste – 0.00
Electricity Power, European average – 2.50

[21] Werner, S. Guidelines for assessing the efficiency of district heating and district cooling systems. Work package 3, Euroheat & Power, Brussels, 2006.

[22] Here the formula is proposed by researchers from University of Liège.

$$f_{p,DH} = \frac{\sum E_j * f_{p,j} + E_{aux} * f_{p,el} - E_{CHP} * f_{p,el}}{E_{del}}$$

where:

$E_j -$ the amount of the j[th] primary energy consumed by the network,

$f_{p,j} -$ the primary energy factor related to an energy source,

$E_{aux} -$ the sum of auxiliary and pumping electric consumption,

$f_{p,el} -$the primary energy factor for the power plants,

$E_{CHP} -$ the amount of electricity provided by the CHP plant if any is installed,

$E_{del} -$the amount of thermal energy delivered to the consumers.

- **Relative importance of losses**, RIL, which provides the amount of heat loss consumed by the network, and compares the lost heat to the heat delivered to the consumers. CHP is not considered in this indicator. The formula is provided below:

$$RIL = \frac{E_{loss} + E_{aux}}{E_{del}}$$

where:

$E_{loss} -$ the amount of energy lost in the district heating network, e.g. thermal loss through pipes, water replenishment, etc.,

$E_{aux} -$ the sum of auxiliary and pumping electric consumption,

$E_{del} -$the amount of thermal energy delivered to the consumers.

- **Primary energy efficiency**, PEE, compares all the net delivered energy (e.g. thermal to the district heating network and electric to the power grid) to the primary energy use, and equation is provided below:

$$\varepsilon_{DH} = \frac{E_{del} + E_{CHP} - E_{aux}}{\sum E_j * f_{p,j}}$$

where:

$E_j -$ the amount of the j[th] primary energy consumed by the network,

$f_{p,j}$ – the primary energy factor related to an energy source,

E_{CHP} – the amount of electricity provided by the CHP plant if any is installed,

E_{aux} – the sum of auxiliary and pumping electric consumption,

E_{del} –the amount of thermal energy delivered to the consumers.

- **District heating global efficiency**, DHGE, the ratio between all provided energies and all the necessary energies. This global efficiency is defined to compare networks from a technical point of view enabling the comparisons of different heating systems for buildings, e.g. the networks and a heat pump. The formula is provided below:

$$\mu_{DH} = \frac{E_{del} + E_{CHP}}{\sum E_j + E_{aux}}$$

where:

E_j – the amount of the j[th] primary energy consumed by the network,

E_{CHP} – the amount of electricity provided by the CHP plant if any is installed,

E_{aux} – the sum of auxiliary and pumping electric consumption,

E_{del} –the amount of thermal energy delivered to the consumers.

- **Subscribed Heat Power** by km, SHP, provides an insight of the commercial profitability of a district heating network. The indicator is expressed as the sum of all the total contracted heat power divided by the total length of the network, MW/km.

$$SHP = \frac{P_{contracted}}{N_{DH}}$$

where:

$P_{contracted}$ – total contracted heat power,

N_{DH} – total length of the network.

- **Equivalent to nominal power duration**, H_{eq}, is synthetic indicator, on the duration of equivalent of working at full nominal power. The indicator inscribes inter alia weather

conditions, heat demand characteristics (e.g. dwellings or industrial customers) and networks heat losses. The equation is given below:

$$H_{eq} = \frac{E_{del}}{P_{HP,total}}$$

where:

E_{del} —the amount of thermal energy delivered to the consumers[23].

$P_{HP,total}$ — total heat power capacity.

- **CO2 emissions index** - regarded as a summarizing indicator because it is a result of all the previous parameters. CO2 emissions are related to the use of fossil fuels and therefore CO2 emissions are related to value of primary resource factor[24]; total CO2 emissions of heating systems also depend on the specific emission factor of fossil fuel used, and according to this specific CO2 factor it is possible to assess different DH systems. The calculation is according to the formula below:

$$CO2 = \frac{Q_{CO2}}{E_H + E_E}$$

where:

E_H —the amount of thermal energy produced,

E_E —the amount of electric energy produced,

Q_{CO2} —the amount of CO2 emission into atmosphere.

[23] The amount of thermal energy supplied is the amount of energy billed to subscribers. In the case of a hot water, the amount of water in m^3 supplied by the network to the subscriber installations must be multiplied by a coefficient "q" contractual reflecting losses in buildings – the FR case.

[24] Lower primary resource factor value means lower CO2 emissions; CO2 emissions are almost directly related the value of PRF. Typical CO2 emissions of different heating systems produce CO2 [g/kWh]:
CHP gas – 10
CHP coal – 270
Biomass – 30
Waste incineration – 20
Oil – 360.

- Practical example of application of the District Heating quality indicators that are mentioned up to this point, is supplied in Annex 1 of this Report. The indicators are used for testing purposes by the authors[25].
- **Weighted service interruption rate** – inability to operate when demanded, weighted against every substation, for any reason, including incident, maintenance works, repair, modification or expansion in generation plant or the distribution network. the formula is depicted below:

$$WSIR = \frac{\sum P_j * t_j}{8760 * P_{contracted}}$$

$P_{contracted}$ – total contracted heat power,

P_j – capacity substation j,

t_j – interruption time of substation j.

- **Water consumption index** – indicates the amount of water m^3 used per MWh of delivered thermal heat. The formula is below:

$$WI = \frac{Q_W}{E_{del}}$$

where:

Q_W –the amount of water consumed,

E_{del} –the amount of thermal energy delivered to the consumers.

- **Severity of incidents in the network** – index depicts how severe incidents are in the system over time, measured as total cost of incidents against total fixed costs of operations over period of time. The costs of incidents, to repair the damages caused, in the formula below shall include the share of costs covered by insurance companies or other possible cost reductions by third parties, since the index is designed to measure the total financial burden (expense) of incidents regardless who takes the financial burden of these. The formula is provided below:

$$SIN = \frac{C_{I,t}}{C_{FC,t}}$$

[25] P.E. Pacot, S. Reiter, 2011. Quality indicators for district heating networks. Research paper.

where:

$C_{I,t}$ – total amount costs incurred as result of incidents,

$C_{FC,t}$ – total fixed costs of the network.

- **Consumer surveys in place**[26] – existence of quality investigation practices, total scores surveys. Yes/No – quantitative changes over time – overall quality rating survey. The survey shall collect the opinions of users resulting from difference of services expected and services received. Such investigation aims at (i) knowing the expectations, priorities, customer dissatisfaction reasons, etc. (ii) measuring satisfaction levels, the evolution of satisfaction in time, etc., (iii) collecting ideas, identifying points of improvement, etc., (iv) using the survey results for management decisions.
- **Claims**[27] – number of consumer claims per period time (year).
- **Requests to explain bill**[28] – number of requests per year to explain a bill to consumer.
- **Availability of means to monitor consumption**[29] - for consumer to monitor their consumption patterns and possibly to change it; for housing services providers to rapidly billing their clients in case, when they leave premises; for analysis of possible leaks of fraud. Here the electronic systems are considered.
- **Meeting users**[30] – number of meetings with consumer representatives per period of time (year).
- **Initiatives for consumer benefit**[31] – number of actions, initiatives to supply consumers with tips, information, and other actions reducing informational asymmetry over period of time (year). The examples include tips, advises and information publication on energy certificates, energy savings, energy consumption per m^2, supply of information under contract.
- **Wide scale campaigns** [32]– existence of info campaigns to citizens, number per year.

27.

[26] Suggested by IGD & AMF (France), in their setting of 23 quality indicators.
[27] Suggested by IGD & AMF (France), in their setting of 23 quality indicators.
[28] Suggested by IGD & AMF (France), in their setting of 23 quality indicators.
[29] Suggested by A. Zabasta, N. Kunicina, L. Ribickis, 2012. The Problem Issues of Intelligent Monitoring and Control of CIS in Latvia.
[30] Suggested by IGD & AMF (France), in their setting of 23 quality indicators.
[31] Suggested by IGD & AMF (France), in their setting of 23 quality indicators.
[32] Suggested by IGD & AMF (France), in their setting of 23 quality indicators.

Quality indicators used for Incentive based regulation in Bulgaria, by KEVR. Drinking Water Supply and Sewerage Utilities

28. The general comment regarding Bulgarian situation is that the last "wave" of price reviews was conducted in 2009[33], and in 2013 the regulatory period was extended for 2 years, and the second extension of the period is conducted in 2015 until 2017. The great risk is that – under real regulatory period of 9 years – the connection between actual operations of entities and the prices these entities apply might have been lost, with all the consequences following.
29. **Quality of services** – the concept of service quality is provided in the Law:
    - The Law establishes 15 Key Performance Indicators and name them as the main measures for quality of service of water supply and sewerage operators:
        - Penetration (coverage) of water supply;
        - Drinking water quality;
        - Continuity of water supply;
        - General water losses in water supply system;
        - Accidents in water supply system;
        - Pressure in water supply system;
        - Penetration (coverage) of sewerage;
        - Quality of sewerage;
        - Accidents in sewerage system;
        - Flooding of regulated land, owned by third parties;
        - Exploitation efficiency;
        - Financial efficiency;
        - Timing of response to users complaints;
        - Timing of connection of new users to sewerage system;
        - Personnel to number of users;
    - Over 50 KPIs[34] are used for regulatory purposes as targets for all entities; the Ordinance of KEVR established the target rates for every KPI (sub-KPI), which were considered to be achieved within 10 years period (by 2016);

[33] The first regulatory period was 2006-2008, the second period was envisaged to be 2009-2013.
[34] The detailed list of Bulgarian KPIs is provided under Subtask 1.1

- The annual reporting by entities allow to track yearly the progress towards the targets, and for the progress assessment the formula is used as provided below:

$$K = \sum(\delta_i * K_i) = \sum\left(\delta_i * \frac{K_{i,acheived}}{K_{i,targeted}}\right)$$

- The business plans of entities had to ensure coherence between quality targets (target KPIs), regulated revenues / tariffs and regulated costs, additionally offering efficiency benefits; however, under the prolonged regulatory period (up to 9 years) the actuality of the business plan must have been lost, prolongation without systematic revision might prevent the regulator and entities from timely correction of their actions to calibrate the movement from "here" to "there";
- The new draft Ordinances of regulation of quality are under way in Bulgaria[35], and entry into force is planned for by January 2017. The new quality indicators (yes, KEVR names them as quality indicators) and established targets are the following:
    - 1 - coverage with water supply – 99%,
    - 2a - quality of drinking water in large systems – 99%,
    - 2b - quality of drinking water in small systems – 98%,
    - 2c – monitoring of drinking water quality – 100%,
    - 3 – continuity of water supply (non-interruption) [36] – 8,
    - 4a – general water losses in water supply system, and reduction deadlines [37] - 15 m^3/km/day;
    - 4b - general water losses in water supply system and reduction deadlines [38] – 47%,
    - 5 - accidents in water supply system [39] – 60 accidents/100km/year,
    - 6 - pressure in water supply system [40] – 100%,
    - 7a – penetration of wastewater collection system – 75%[41],
    - 7b – penetration of wastewater treatment – 75%[42],

[35] Draft announced just 2 weeks ago.
[36] Measured as interruption hours against total due supply hours, weighted by consumers.
[37] Measured as total water supplied to system minus water sold against total length of water supply network and 365 days.
[38] Measured as nonrevenue water against total water supplied to system.
[39] Measured as total number of accidents against total length of the network (inside-house branches not included).
[40] Measured as number of areas having continuous debit flow and pressure metering, with 15 min of data recording interval and data electronic storage in database, against total number of areas by entity.
[41] Corresponding to 100% of penetration for sites over 2000 persons.
[42] Corresponding to 100% of penetration for sites over 2000 persons.

- 8 – quality of treated wastewater [43] – 93%,
- 9 – accidents in sewerage system – 120/100km/year,
- 10 – floods in properties of third parties due to malfunction of sewerage system – 0.5/10.000 connections,
- 11a – water supply energy efficiency – 0.45 kWh/m^3,
- 11b – wastewater treatment energy efficiency – 0.25 kWh/m^3,
- 11c – utilization of sewage sludge – 100%,
- 11d – renovation of water supply network [44] – 1.25%,
- 11e – active leakage control [45] – 1.25%,
- 12a – cost efficiency of water supply [46] – 1.10,
- 12b – cost efficiency for wastewater collection [47]– 1.10,
- 12c – cost efficiency for wastewater treatment [48]– 1.10,
- 12d – revenue collection rate [49] – 95%,
- 12e – effectiveness water meters management [50] – 20%
- 12f – effectiveness of building meters management [51] – 90%
- 13 – timely of response to users complaints [52] – 100%,
- 14a – timely connection to water supply system[53] – 100%,
- 14b – timely connection to sewerage system [54] – 100%,

[43] Measured as number of samples complying with requirements against total number of samples examined.
[44] Measured as length of network renovated against total length of network, and inside-house branches not included.
[45] Measured as length of network having implemented regular inspection items (to detect and remove leaks) against total length of network.
[46] Measured as income against costs.
[47] Measured as income against costs.
[48] Measured as income against costs.
[49] Measured as (total yearly sales minus change in receivables over year) against (total yearly sales and receivables for previous year)
[50] Measured as number of meters installed new and tested with metrology services over reporting year against total number of meters, individual meters.
[51] Measured as number of meters installed new and tested with metrology services over reporting year against total number of meters, building meters.
[52] Measured as total number of responses to consumer complaints against total number of consumer complaints, entire numbers covering water supply, sewerage, and billing.
[53] Measured as connection fulfilled within binding time limits against total number of connections conducted during the reporting year.
[54] Measured as connection fulfilled within binding time limits against total number of connections conducted during the reporting year.

- 15a – efficiency of personnel engaged in water supply - 4 persons[55] /1000 connections;
- 15b – efficiency of personnel engaged in sewerage collection and treatment – 3 persons[56] /1000 connections;

- The individual regulatory approach is planned to be applied to every entity with regard to their targets reachable within next regulatory period and reflected in their next business plan; the regulator obliges to establish conditions for obtaining the necessary revenues to reach the established quality targets;
- bearing in mind the individual quality targets for every entity and bearing in mind the necessity to provide with adequate revenue for achieving the targets, the general regulatory revenue formula is established by KEVR:

$$R_t = R(BP_t) * (1 + I - X)_t \pm Z$$

Where

$R_t -$ regulatory revenue for year t,

$R(BP_t) -$ revenue according to business plan for year t,

$Z -$ coefficient taking into account difference in quantities projected and actually served.

$I -$ inflation t,

$X -$ composite coefficient of the entity. The coefficient X is sum as provided below:

$$X = E + Q_C + Q_I + Y$$

E - efficiency coefficient, established by the regulator for the whole regulatory period for the entity in question;

Q_C - coefficient between estimated and actual costs, resulting from implementation of new activities and / or operation and maintenance of new assets, as established by the regulator,

Q_I - coefficient between estimated and actual investment, that are implemented to made to reach individual annual target levels of quality indicators,

[55] Person as a full time employee equivalent.
[56] Person as a full time employee equivalent.

Y - performance with quality indicators against established for the whole period individual targets.

30. **Network losses'** limits - an integral part of quality indicators' family, and will not be discussed additionally.
31. **Currency risks** are not specifically addressed, however, it seems that the following provision might be used in considering rists if the currency risk comes to agenda:
    - "The prices include costs pursuant to [...] Law, as well as other economically justified costs at the discretion of the Commission to ensure the sustainability of the provision of water and sewerage service."
32. **Fines are not** considered as recoverable via regulated revenue / tariff – "For purposes of price regulation, the Commission does not include in the eligible costs: (...) the fines imposed by the Commission or other state bodies, as well as delay interest, penalties and other payments related to default concluded contracts".

Quality indicators used for Incentive based regulation in Lithuania, by VKEKK. Drinking Water Supply and Sewerage Utilities

33. Water sanitarian indicators and Sewerage sanitarian indicators are established by the Minister of Environment and the Minister of Health. The requirements of sanitary quality are not in the agenda of Regulator. Complaints regarding water sanitary issues are investigated by State Authority for Food and Veterinary Control.
34. **Quality of services** is defined[57] as:
    - Drinking water supply (continuity of service) – ensure supply to such an extent that every consumer is able to be supplied with at least 200 l/day quantity of drinking water;
    - Pressure of drinking water supply – falling within ranges of 0.1 MPa and 0.6 MPa;
    - Non-Interruption of drinking water supply – max number of interrupted consumers is set at 10% a year, with interruptions due to necessity to change meters not included into the number; max 0.3 times / km / year of planned interruptions; if interruption is longer than 12 hours, the entity is obliged to supply drinking water from alternative sources (automobiles, bottles, etc.) to at least 30 l / day / consumer within max distance of 100 m;
    - Quality of drinking water – microbiological purity, chemical quality of water is regulated by Sanitary norm[58]; the entity is responsible for the quality of water until house inlet;
    - Consumer service – the entity must provide consumers with phone and email, to communicate 24 hours a day (auto-answering is allowed); publicly announce contacts for the case of incident; in website to publish contacts of other entities engaged in collection of sewage by automobiles; investigate and analyze consumer complaints, provide annual report on the issue to the regulator; once a year organize and conduct consumer survey, supply regulator with the results of the survey;
    - Non-Interruption of sewerage collection - max number of planned interrupted consumers is set at 5% a year; if interruption is longer than 12 hours, the entity is obliged to supply sewerage collection via alternative means (automobiles, etc.);

[57] Established by the Ministry of Environment
[58] Established by the Ministry of Health

- Sewage non-flooding – in the case of flooding, to take actions immediately;
- Non-Interruption in sewerage treatment.

35. Quality matter treatment in regulatory costs:
    - Methodology approaches some parameters of quality indirectly; .e. those parameters that are related to non-interruptions (equals to costs of regular maintenance to avoid and costs of recovery after interruptions and accidents) are approached via cost limits to be included in revenue/tariff; and the cost limits are established verifying against cluster average;
    - Principal regulatory practice (as regards the costs and recovery after incidents happen in a system) is encouraging entities to use insurance instruments, and insurance companies would cover the costs if any – the Methodology has clear statement that insurance costs are eligible costs for regulatory recovery.
36. **Network losses** limits are regulated by the Methodology. Network losses in Lithuania are regarded as an issue of general efficiency, and the Methodology sets the following limits of network losses that can be maximally included into regulated revenue/tariff:
    - 20% network losses in Drinking water supply network,
    - 10% network losses in inside multi-apartment house systems,
    - 20% infiltration in Sewerage network;
    - the factual percentage of network losses is verified against the aforementioned regulatory standard, and the less number is used for revenue / tariff determination;
    - the investment projects reducing percentage of network losses are present in long-term investment program, and depreciation from these assets is included into regulatory revenue / tariff.
37. Bad debts are not covered by regulating Methodology.
38. **Currency risks** are not specifically addressed in regulatory legislation.
39. **Fines[59] are not** considered as necessary / eligible costs and are not **included into tariffs** / revenues of regulated entities. This request of non-inclusion is provided in the Law. The fines, if any, would be covered by internal resources of entities. Practically this would mean factual reduction of profits of ongoing year or future periods. The fines for non-compliance to quality requirements:

[59] The regulation on substantial fines appeared in the Law in 2014 autumn, and this is a new development in the sector, balanced to the regulation in other sectors regulated by National regulator.

- For non-publication of information requested by the Law or by other legal acts, including regulatory legal acts, fine from 290 EUR to 0.5% of annual revenue from water supply and sewerage activity;
- For ignorance of Regulator's requests and obligations, for breaching water quality and sewerage treatment quality requirements, fine from 290 EUR to 1.0 % of annual revenue from water supply and sewerage activity; the same range fine is foreseen for engagement into activity without license;
- For breaching the principles of security, efficiency, reliability, non-discrimination in entity's activities, fine from 290 EUR to 2.0 % of annual revenue from water supply and sewerage activity.
- Fines are imposed by Regulator, within 6 months after the breach is conducted, and might be removed by Court decision solely;
- Fines are paid to State budget.

40. Additional comment for the quality area in Lithuanian water regulation. According to analysis made by VKEKK in 2014, which aimed to inform on the results of the sector development in the context on heavy financing during 2008-2015, as of 970 mln. EUR total investment (mostly public) into infrastructure of water supply and sewerage, general strategic objectives are not reached, *inter alia*:
    - Water supply services are provided to 86.4% and sewerage services are provided to 82.8% of population instead of target 95% by 2015;
    - 95.4% of consumers are provided with water quality meeting the Hygienic requirements instead of target 100%;
    - 99,2% of wastewater is treated up to meeting the requirements of the Wastewater Regulation instead of target 100%.
41. Taking into consideration the information presented above, it is to be concluded, that quality measure is taken into regulatory revenue / tariff indirectly, even if the element per is not expressively demonstrated in revenue formula.

Quality indicators used for Incentive based regulation in Latvia, by SPRK. Drinking Water Supply and Sewerage Utilities

42. The Cabinet[60] issues Drinking water mandatory safety and quality requirements, monitoring and control arrangements in Latvia. Latvian Environment, Geology and Meteorology Centre, Health Inspectorate and State Environmental Service Radiation Safety Centre are mandated public bodies for quality of drinking water.
43. The SPRK was supplied with regulatory functions in water sector in 2009, after general reform for municipal utilities (previously the regulation was conducted by municipal bodies), the first Methodology was established in 2010, with subsequent amendments is 2011, 2012, 2013 and the practice of water and sewerage sector regulation there is expanding.
44. **Quality of services** is defined as:
    - Drinking water safety - conformity with microbiological, chemical, radioactivity requirements, established by the Cabinet; the regulated entity is obliged to develop a monitoring program with regard to water quality;
    - Consumer service – to respond to complaints within 15 days, term might be extended to 30 days if the subject of complaint requires investigation; annual report on consumer complaints is supplied to regulator[61];
    - Non-interruption of public service provision – as a general requirement to those seeking for license / permission;
45. The Law on Regulating of Public Utilities provides the principal statement of reimbursement of losses to consumers due to failing of entity: "Public services are provided by technical regulations, standards and contractual conditions appropriate quality of public services. If the provider of public services cannot be provided over a period of technical regulations, standards and contractual conditions appropriate quality of public services, it will reimburse the losses caused to the user in accordance with the terms of the contract or regulatory requirements."
46. **Network losses** issue[62]:

[60] Government of Latvia
[61] Regulator issues annual report on consumer complaints for the entire sector.
[62] There is recognition that presently high amounts of water losses and amounts of infiltration makes a regulatory challenge.

- the Methodology provides wide definition of losses[63], and regulator collects information on projected losses while making the tariff revision, however, the Methodology sets a single clear limit for tariff purpose - 0% of network losses in inside building systems;
- the Methodology provides recognition that infiltration is treated as "other wastewater"[64], regulator collects data of this other wastewater quantities treated, and the Methodology does not set limits for infiltration cost coverage;
- the Methodology provides prohibition to include costs of maintenance of storm water collection network into wastewater costs recovered by regulatory tariff;
- The Investment plan of the entity for coming years is supplied to regulator at tariff revision exercise
- In those cases, when entity operates the network, assets of which are 40 years and more of age, and share of the aged asset makes 50% or more of the network, this entity may use WACC and RAB rules for return calculation at the tariff, instead of the rule of 7% profitability on incurred costs, . This way, the regulator has set up incentives for additional investment and the upgrade of the network, which would pave the way for lower network losses.

47. Insurance costs are covered by regulating Methodology.
48. **Currency risks** are not specifically addressed in regulatory legislation.
49. **Fines are not** considered as recoverable via regulated costs and are not included into tariffs / revenues of regulated entities, according to the Methodology. This falls under general request of the Law on Regulator of Public Utility "Tariffs shall be determined to the extent that users of the tariff payments cover economically justified public service costs (...)", underlying the notion of economic justification instead of full coverage of costs incurred.

[63] Including losses related to the accident elimination and network maintenance, consumption associated with fire-fighting, measuring errors, losses related to inaccurate record of quantity of water factually supplied to users, consumption of water for technological needs.

[64] "Quantity of other treated wastewater – the volume of the treated wastewater, which has not been collected in accordance with meters for the commercial accounting or the water consumption norms used in the settlement of accounts (infiltration, technological wastewater)"

Quality indicators used for Incentive based regulation in Estonia, by Konkurentsiamet. Drinking Water Supply and Sewerage Utilities

50. Ministry of Social Affairs and Ministry of Environment are mandated public bodies in water and sewerage sector. Regulation of entities is of mixed type – larger one are regulated by CA, and smaller ones are under municipal bodies. The centralized regulation (to larger ones) by CA has started relatively recently – in 2010-2011.
51. **Quality of services** is regulated from health and environment point of view:
    - Drinking water quality - conformity with microbiological, chemical requirements, radiological parameters established by the Ministry of Social Affairs; the regulated entity is obliged to develop an action plan improving to water quality;
    - Environmental impact – contaminants (pollution) indicators (BOD, etc.);
    - Connection rate to wastewater system – 98% of pollution to be collected via sewerage system by 2013;
52. Regulating practice is the one that "prices shall cover justified operating expenses, [enable to] make investments in order to ensure the sustainability of the existing public water supply and sewerage systems, comply with environmental requirements, and comply with quality and safety requirements (...)."
53. **Network losses** - limits of losses are included into revenue / tariff according to individualized approach. For those entities that are not operating under approved investment program (by municipal body), percentage of network losses is approved as predicted under factual data for the past years. For those entities, that have their approved investment program (by municipal body), the network losses are taken as projected while making the economic evaluation of the investment projects (before investment); in parallel, CAPEX related to investment are reflected in regulated revenue / pricing.
54. At the beginning of regulatory practice over water and sewerage sector, back in 2011, CA has declared that in pricing area among main principles is "clear target to operational efficiency". The regulatory approach described above proves Estonian regulatory system focus on efficiency: to select efficient investment projects (delivering efficiency increase) and then reflect the declared delta in regulated revenue.
55. Bad debts are not covered by regulating Methodology, and this is stated clearly.

56. Brokerage fees paid are not covered by regulating Methodology, and this is stated as well.
57. **Currency risks** are not addressed in regulatory legislation.
58. **Fines and penalties are not** considered as eligible costs and are not **included into tariffs** / revenues of regulated entities. This request of non-inclusion is provided in the Methodology in clear manner. The Law foreseen maximum penalty size at 3.200 EUR for failure to comply to regulations.
59. Additional comment for the quality area in Estonian water regulation. According to National Audit Office[65], in their report attempting to conclude the investments made in water management have helped to achieve the required quality of waste water treatment and drinking water in the public water supply and sewerage systems, whether the water management infrastructure is sustainable and whether the investments have helped to improve the condition of the water entities.
    - Over the last funding period of 2007-2013, in Estonian water sector there was invested total amount of 466 mln EUR of public money (EU and state funds). This amount was not sufficient to achieve the compliance with requirements, and 165 mln EUR is foreseen for the next financial period of 2014-2020;
    - As for the sustainability of the system, the NAO stated that principle sustainability is not fully implemented in pricing, and the 4% rule[66] is indicated as the valid threshold for more efficiency to introduce into operations of the sector. The low motivation of entities was explained:
        - "Two-thirds of the water undertakings interviewed by the National Audit Office felt that regulation of the price by the Competition Board does not motivate them to become more efficient and effective. For example, there is not much interest is keeping expenses low if investment-based return (profit) is regulated. Approval of a strictly cost based price does not motivate undertakings to become more efficient either, as the price of water and cash flow will then decrease."
    - The recommendation of the NAO to the Regulator was the following:
        - "To analyze the methodology of approval of the price of the water service currently based on the Public Water Supply and Sewerage Act to find the best solution to the establishment of the water price, which would motivate water

[65] Sustainability of drinking water and waste water systems developed with state support and impact on achievement of environmental goals. Report of DEC 2013, aiming to conclude whether
[66] Bill for water service shall not account for more than 4% of household income.

undertakings to become more efficient without sacrificing the quality of their services and which would guarantee the achievement of environmental goals at the same time".

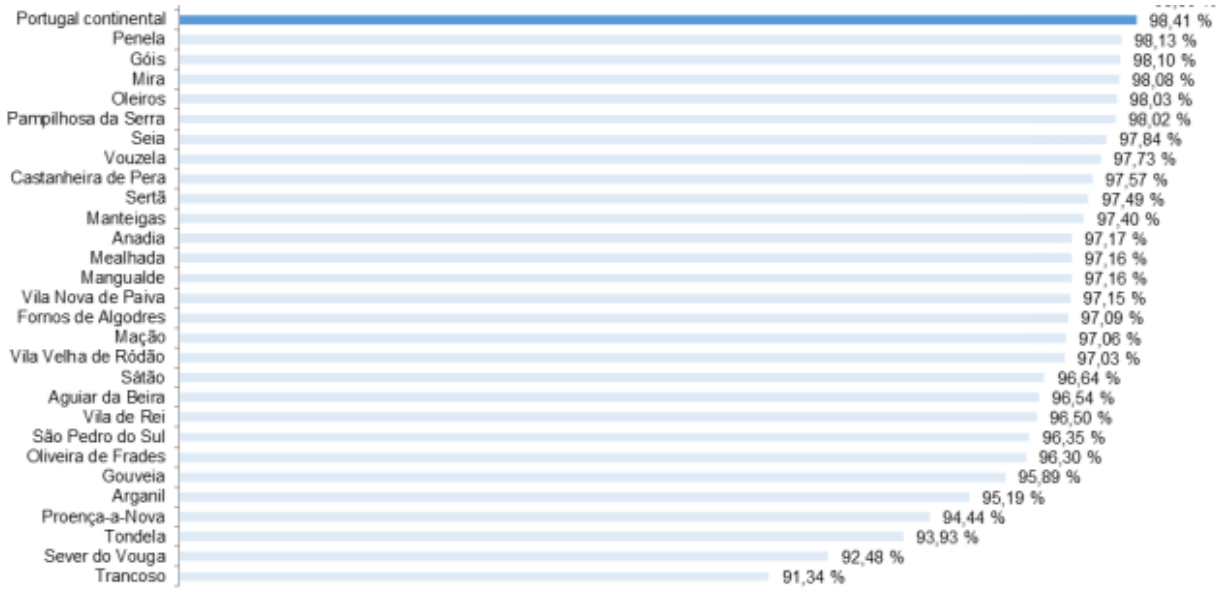
- The answer delivered was positive, and so it is to be expected further developments of the Methodology towards better incorporation of the link between incentives and quality & efficiency;
- Reporting was another issue underlined strongly by the NAO, and this allows to expect further development of reporting system in Estonia.

Quality indicators used for Incentive based regulation in Portugal, by ERSAR. Drinking Water Supply and Sewerage Utilities

60. Some authors call the Portuguese system the "name and shame" system. In Portugal, the benchmarking is the pillar of the regulatory system – ERSAR applies a set of indicators and annually publishes the results. ERSAR uses the system of color-balls / scores with different colors associated to the performance highlighted. Comparing each performance indicator with benchmarks, if the utility has a good score, it gets a green ball, low performance corresponds to red ball, and average score – yellow ball. The information on performance is public for every individual operator. The example of information publication is provided below.
61. As for indicators' list, in Portugal there is used a "second-generation" list. As regards namely quality of service, 4 indicators belong to the family of indicators depicting "Protection of the user interests". The table with the entire indicators' set is presented below.
62. As for quality indicators inclusion into regulated revenue / tariff it shall be noted, that in Portugal cost plus revenue regulation is used (with WACC/CAPM as return), and possible movement towards another type of regulation (namely, incentive based regulation - revenue cap) is presented as being at discussion stage.

Figure 00. **Performance information publicity – some examples**

Concelho	2010	2011	2012	2013	2014	Variação 2014 - 2010	Variação 2014 - 2013
Portel	98,97 %	99,02 %	98,32 %	99,64 %	99,85 %	0,88 %	0,21 %
Redondo	98,97 %	98,61 %	97,91 %	99,30 %	98,96 %	-0,01 %	-0,34 %
Reguengos de Monsaraz	99,51 %	98,96 %	90,57 %	98,44 %	100,00 %	0,49 %	1,56 %
Rio Maior	98,32 %	96,40 %	98,60 %	98,23 %	99,32 %	1,00 %	1,09 %
Salvaterra de Magos	99,52 %	99,28 %	99,66 %	99,64 %	99,76 %	0,24 %	0,12 %
Santarém	99,09 %	99,48 %	98,38 %	99,90 %	99,79 %	0,70 %	-0,11 %
Santiago do Cacém	97,38 %	97,96 %	98,28 %	98,28 %	97,94 %	0,56 %	-0,34 %
Serpa	99,51 %	99,73 %	100,00 %	100,00 %	99,87 %	0,36 %	-0,13 %
Sines	98,31 %	99,35 %	99,05 %	99,06 %	99,43 %	1,12 %	0,37 %
Sousel	99,42 %	99,11 %	98,21 %	98,21 %	98,78 %	-0,64 %	0,57 %
Vendas Novas	99,76 %	99,35 %	100,00 %	98,90 %	99,08 %	-0,68 %	0,18 %
Viana do Alentejo	89,33 %	99,17 %	100,00 %	100,00 %	100,00 %	10,67 %	0,00 %
Vidigueira	98,19 %	99,62 %	99,62 %	99,24 %	99,81 %	1,62 %	0,57 %
Vila Viçosa	97,80 %	98,31 %	99,74 %	99,22 %	100,00 %	2,20 %	0,78 %



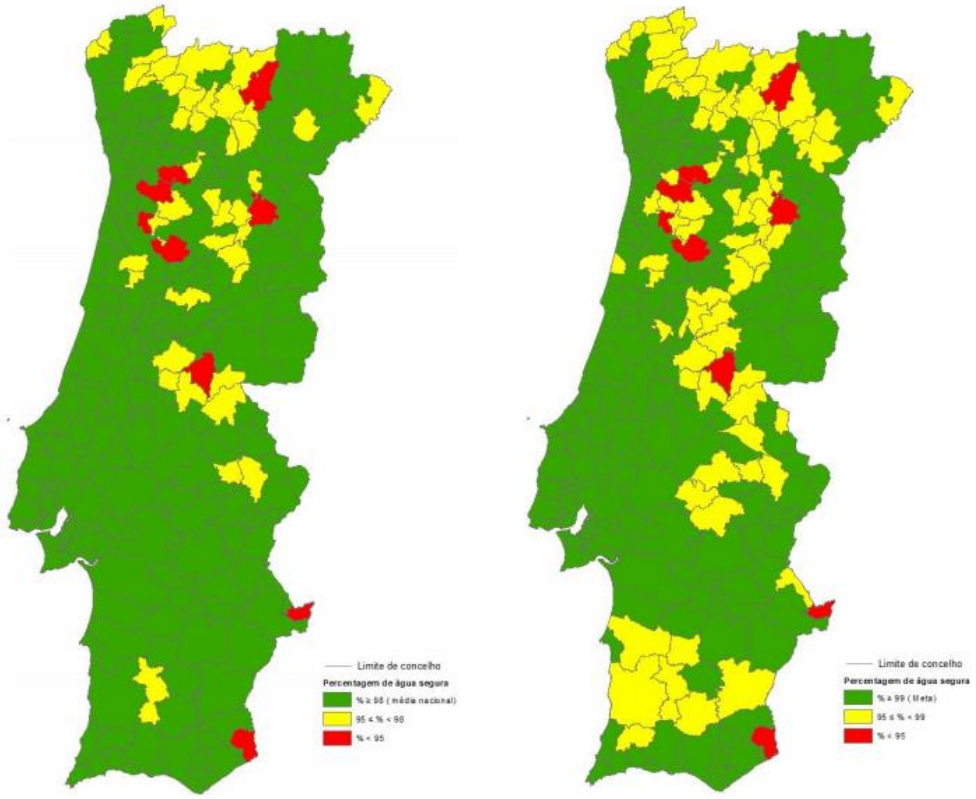


Table 1. **Benchmarked indicators in Portugal**

	Group of performance indicators	Subgroup of performance indicators	Performance indicator
water		User service accessibility	Service coverage
			Average water charges

	Protection of the user interests	Quality of services supplied to users	Service interruptions
			Water tests performed
			Quality of supplied water
			Answers to written complaints
	Sustainability of the operator	Economical and financial sustainability	Operating cost coverage ratio
			Unit running costs
			Solvency ratio
			Non-revenue water
		Infrastructure sustainability	Fulfillment of the water intake licensing, %
			Treatment utilization, %
			Transmission/distribution storage capacity, days
			Mains rehabilitation, %/year
			Service connection rehabilitation, %/year
		Operational sustainability	Failures, #/100km/year
		Human resources sustainability	Employees #/100km/year or #/1000 connections
	Environmental sustainability		Water losses m3/km/day
			Utilization of water resources, %
			Efficiency of energy usage, kWh/m3/100m
			Final destination for sludge, %
Wastewater	Consumer care adequacy		Service coverage
			Affordability of charges
			Occurrence of flood
			Answers to written complaints
	Sustainability of the operator		Operating cost coverage ratio
			Adherence to service
			Adequacy of treatment capacity
			Rehabilitation of collectors
			Accidents in collecting system
			Adequacy of human resources
	Environmental sustainability		Efficiency of energy usage
			Adequate disposal of sewage collected
			Emergency discharge control
			Wastewater tests performed
			Compliance with required parameters
			Sludge treatment

Quality indicators used for Incentive based regulation in France. Drinking Water Supply and Sewerage Utilities

63. In France, all drinking water supply and sewerage entities fall within the responsibility of municipal authorities or inter-municipal bodies. The overall governance of the sector, as it is recognized, largely depends on monitoring indicators, which are designed as steering tools and targeting results. The Ministerial Order and Decree dated 2nd May 2007 define a list of 29 statutory performance indicators to be calculated annually by each water and sanitation service. The list of KPIs is provided in Table 2 below
64. In the context of regulatory performance indicators, used as steering tools, the network efficiency rate has been selected to play a key role in water services sector. This indicator is defined as the ratio between, on the one hand, the volume consumed authorized plus the volume sold in bulk to other public drinking water services, and, on the other hand, the volume produced plus the volume purchased in bulk to other water services. It is calculated as follows:

$$NER = \frac{Volume_{consumed\ authorized} + Volume_{sold\ in\ bulk}}{Volume_{produced} + Volume_{purchased\ in\ bulk}}$$

65. In fact, NER has little to do with quality, in the sense of this Report, however this French example serves as illustration that in EU "**absolute fines attributed**" **as incentive** is practically used. A Decree of January 2012 sets a specific level of NER which all water entities should reach by 2015. If entities fail to comply with this threshold, they may face a 100% increase in the intake tax they pay to the French water agencies provided no action plan is undertaken to improve the performance of the service. The legislation has been elaborated to provide "a strong incentive" to water services to better manage their assets and more specifically their networks. The summary of the legislation is below:
    - "The increase in the rate for the use of "drinking water" is applied if the action plan is not established when the performance of the water distribution network efficiency rate calculated for the previous year or, in the event of significant changes in water sales, over the last three years and, expressed in percent, is less than 85 or, when this value is not reached, the result of the sum of a fixed term equal to 65 and to one fifth of the value of the linear

consumption index equal to the ratio between, on the one hand, the average volume consumed daily by users and for service requirements, increased by water sales to other services, expressed in cubic meters, and on the other hand, the network length excluding connections expressed in kilometers. If raw water intakes subject to specific allocation rules exceed more than 2 million m^3/year, the value of the fixed term is 70. The action plan includes an annual monitoring of the water distribution network efficiency rate, taking into account the water supply of the year for which the rate of water loss exceeded the value specified in the previous paragraph. Under the action plan, the detailed description of the asset of drinking water transport and distribution is updated indicating the areas which have been subject to research of water loss through distribution networks as well as repairs.[67]":

Table 2. **List of French regulatory performance indicators for water and sanitation services** (quality indicators for up part of the entire set)

Water performance indicators	**Collective sanitation performance indicators**
Microbiological compliance rate	Service rate by wastewater collection networks
Physico-chemical compliance rate	Compliance of effluent collection with Decree 94-469
Asset knowledge and management index	Compliance of sewage treatment equipment with Decree
Network efficiency rate	Compliance of sewage treatment plants with Decree
Linear index of unaccounted volumes	Asset knowledge and management index
Leakage index (losses per 1 km of network)	Compliance of sewage treatment equipment performance with the provisions of the individual act enforcing water regulations
Network renewal rate (% of network length, over the last 5 years; period)	Effluent overflow rate in consumers premises (compensation requests sent by third parties due to malfunction of the service per number of inhabitants supplied)
Water resource protection improvement index (%, administrative and operational policy measured)	Network renewal rate
Sum of debt waivers & payments to a solidarity fund	Number of collection network points requiring frequent dredging per 100 km linear (# of black spots per 100 km of network excluding connections; black spot - structurally sensitive point of the network requiring at least two interventions a year, preventive or curative)
Occurrence rate of unscheduled service Interruptions (no prior warning to consumers)	Sum of debt waivers & payments to a solidarity fund

[67] Salvetti, M. The network efficiency rate: a key performance indicator for water services asset management? Institut d'Administration des Entreprises, Paris, 2014.

Compliance rate of new customer maximum connection times	Rate of sludge evacuated according to compliant processes (% of sewage treatment plants sludge evacuated according to compliant processes)
Debt extinguishment period	Index of knowledge on discharge into the natural environment
Rate of unpaid bills	Debt extinguishment period
Complaint rate (excluding complaints on price per 1000 consumers)	Rate of unpaid bills
	Complaint rate (excluding complaints on price per 1000 consumers)

Quality indicators used for Incentive based regulation in UK. Drinking Water Supply and Sewerage Utilities

66. The list of performance indicators used in UK, by OfWat, was provided under subtask 1.2, in relevant Report. Majority of these indicators shall be attributed to quality indicators groups.
67. Here the list of indicators shall not repeated, however, as for demonstrating quality performance impact for incentive based regulation in UK, the following need to be mentioned[68]:
    - Environment Agency determines package of Environmental indicators, and tracks performance over theme. Ofwat "can take action where the companies fail to deliver these improvements – for example, by making them pay back money for things they did not deliver" ;
    - Customer indicators, a package, is considered to measure the consumer care dimension of service quality. Here important two points:
        - First, regulated entities have to keep up with guaranteed standards of service, and if they fail, they must pay real money to consumers, and the "price" for failing is provided below. This is how penalties are employed as incentives for quality standard keeping and improvement;
        - Second, Customer contacts and satisfaction form part of service incentive mechanism (SIM). OfWat takes account of entities' performance when OfWat decides on the prices for regulatory period. The poorest performers during are penalized and the best ones are rewarded. For the latest review, there was used the rewards/penalties range of -1% to +0.5% of total revenue, which translated to RoRE impact was between -0.5% to +0.25%;
    - Reliability and availability indicators' package enables to keep track whether entities can provide reliable services to you over the long term – and protect the environment. OfWat calls it serviceability, and if entities have lower rates, they must restore their network. In the cases entities are not restoring assets, OfWat takes measures to clawing back money for customers.

[68] The complex institutional structure for water and sewerage industry regulation in England and Wales is provided in Annex 2.

68. OfWat may impose **penalties** up to 10% of entity's turnover. Penalties' costs cannot be included into regulated revenue / tariff, i.e. consumers shall not cover expenses for company to pay penalties. There are some examples of OfWat decisions:
    - Severn Trent Water Ltd for deliberately misreporting customer service performance data a penalty equal to company's 2.9% of annual turnover, and for providing sub-standard services to customers a penalty equal to company's 0.1 % of annual turnover, 2008;
    - Thames Water Ltd. for deliberately misreporting customer service performance data a penalty equal to company's 0.6% of annual turnover, and for providing sub-standard services to customers a penalty equal to company's 0.1 % of annual turnover, 2008;
69. In some cases, **regulated revenue** might be **reduced** with the size of penalty imposed, and recent example serves to illustrate:
    - In 2014, after long investigation, OfWat proposed penalty to Thames Water Ltd. at size of 86 mln. GPB for regulatory misreporting, however, after certain process, the agreement was reached that Thames Water Ltd. offers a package of measures for its customers, namely:
        - £79 million reduction to its regulated capital value, plus a financial adjustment to remove any benefit Thames Water received from this expenditure being included in its RCV during 2010 to 2015; this results in lower bills for Thames Water's sewerage customers for years to come; and
        - £7 million spending on customers, over and above what Thames Water would otherwise have spent, over the next five years through increasing the amount of money available to the Trustees of the Thames Water Trust Fund (£2million) to assist customers who are having difficulty paying their bills; and investing £5 million to support additional community projects such as local programs to better protect rivers and improve the natural environment.

Table 3. **Summary of payment amounts that apply in England & Wales, if not complied with guaranteed standards of service**

GSS Regulation	GSS payment, for consumers		Late payment penalty, for consumers	
	Domestic	Business	Domestic	Business
Appointments not made properly	20	20	10	10
Appointments not kept	20	20	10	10
Incidences of low water pressure	25	25	-	-

Incorrect notice of planned interruptions to supply	20	50	20	50
Supply not restored* - initial period	20	50	20	50
Supply not restored* - each further 24 hours	10	25		
Written account queries and requests to change payment arrangements not actioned on time	20	20	10	10
Written complaints not actioned on time	20	20	10	10
Properties sewer flooded internally	Payment equal to annual sewerage charges (Minimum payment of £150. Maximum of £1000)		20	50
Properties materially affected sewer flooded externally20$	Payment equal to 50% of annual sewerage charges (Minimum payment of £75. Maximum of £500)		20	50

* Supply not restored within time notified (planned work) or when supply is interrupted for an extended time under unplanned/emergency situations

Quality indicators used for Incentive based regulation in Lithuania, by VKEKK. District Heating

70. The Law spreads public institution's functions related to quality requirement establishment, compliance monitoring and enforcing greatly in Lithuania. Technical quality and safety is domain of Ministry of Energy and State Energy Inspectorate. Regulator is mandated to consumer care quality dimension and operational quality dimension.
71. **Quality of services** is defined as:
    - Non-interruption of service supply;
    - Respected working regime of heat carrier at the point of purchase, within limited deviations of the heat carrier $\pm$5% average during 48 hours;
    - both criteria are established by Ministerial order.
    - The Methodology by VKEKK states, that "Depending on changes of the entity's reliability and service quality, measured according to the monitoring results, the first scale of profit and the second limit of profit[69] might be increased or decreased by 1% point".
    - VKEKK performs monitoring against the following[70]:
        - Complaints of residential and non-residential users – number of complaints; contents of complaints (prices, terms of contracts, connection to network, reliability of supply, service quality, billing, other); timing of investigation (less than 30 days, more than 30 days); results of investigation (reasoned complaint, non-reasoned complaint),
        - Service quality and reliability – consumer debt amount to end of reporting year and delta over reporting year; interrupted service supply (planned, min/consumer/year; not-planned, min/consumer/year).
72. **Network losses** for the purpose of regulated revenue / tariff by the Methodology:
    - The lower out of two – (i) benchmarked percentage at the relevant cluster of the latest available reporting year, either (ii) individually forecasted percentage taking into due

[69] Profit sharing scale is defined the following way: "if average factual annual profit of entity for the last two years is higher than the established WACC by 2% points (the first scale), the next year revenue from this activity is decreased by 50% of the difference. If average factual annual profit of entity for the last two years is higher than the established WACC by 6% points (the second scale), the next year revenue from this activity is decreased by the total amount above the second scale and by 50% amount above the first scale."

[70] Annual mandatory reports shall be supplied by entities.

consideration the factual percentage of losses over the last regulatory period and the future base-period investment program by the particular entity;

- Losses oversizing the established percentage are not covered with regulated revenue.

73. **Currency risks** are not specifically addressed in regulatory legislation.
74. Bad debts are not covered from regulated tariff, by the Methodology.
75. **Fines are not** are not considered as eligible costs and are not included into tariffs / revenues of regulated entities. The fines, if any, would be covered by internal resources of entities. Practically this would mean factual reduction of profits of ongoing year or future periods. The fines for non-compliance to quality requirements:
    - for non-publication of information requested by the Law or by other legal acts, including regulatory legal acts, fine from 290 EUR to 0.5% of annual revenue from regulated activity;
    - for disregarding of Regulator's requests and obligations, fine from 290 EUR to 1.0 % of annual revenue from regulated activity;
    - for breaching reliability and security in entity's activities, fine from 580 EUR to 2.0 % of annual revenue from regulated activity;
    - fines are imposed by Regulator, and might be removed by Court decision solely;
    - fines are paid to State budget.
76. Taking into consideration the information presented above, it is to be concluded, that quality measure is taken into regulatory revenue / tariff indirectly, even if the element per is not expressively demonstrated in revenue formula.

Quality indicators used for Incentive based regulation in Estonia, by Konkurentsiamet. District Heating

77. The CA conducts district heating price regulation since 2010. The Methodology is developed and established by CA.
78. **Quality of services** situation is as the follows:
    - Technical quality is monitored by CA and targets & achievements of operators throughout the market are placed into price setting schema in clear manner. The indicators of technical quality, the direct area of CA, are the following as provided below, and through the pricing CA accepts such investments which enable to provide all technical minimum requirements:
        - Network losses: 2009 up to 24%, year 2010 up to 22%, year 2011 up to 21%, year 2012 up to 20%; year 2013 up to 19%, year 2014 up to 18%; year 2015 up to 17%, year 2016 up to 16%, from year 2017 not more than 15%;
        - Efficiency of heat production: - using natural gas boilers at least 90%, if new boilers at least 92%; using liquid fuel boilers at least 85%, if new boilers at least 90%; using solid fuel boilers at least 80%, if new boilers at least 85%;
        - Under this approach, technical compliance or non-compliance with quality of service regulatory standard serves as efficiency factor in the context of regulatory revenue.
79. **Currency risks** are specifically addressed in the Methodology.
80. **Fines and penalties are not** considered as eligible to be recovered via regulatory revenue / tariff.
81. Cost of bad debt is not eligible to be included into regulated revenue / tariff.

Quality indicators used for Incentive based regulation in Poland, by URE. District Heating

82. The Methodologies[71] provide general system of price regulation. However, since in Poland ESCO model is popular, the regulation complies with market conditions. For this reason *inter alia*, the Methodology provides detailed prescriptions on connection to the network matter; contractual terms are foreseen in the Methodology, which must be followed by the network operator, while supplying transportation services; the network operator is obliged to conduct annually investigation of its network operation's quality, including inter alia "the nature, causes of failures and disruptions in the supply and consumption of heat, which occurred in heat sources, heating networks, connections and district heating", also "the losses of the heat carrier", "the heat loss and heat output during heat transfer heat distribution network".
83. **Quality of services** is structured as follows. Quality parameters of heat carrier and customer service quality standards include:
    - technical requirements, that are prescribed in detail manner in the Methodology as regards heat carrier deviations in temperature (±%), duration of interruptions planned and non-planned (in days), connection and re-connection to network terms (in hours);
    - consumer care requirements - conditions of cancellation of heat transportation (disclose in contract), deadlines to handle consumer complaints (in days), notifications on planned changes in the system (in days), duration to respond to consumer requests (in hours);
    - the general provision is in place that tariff (including network transport tariff) shall provide rebates for failure to meet the quality parameters of heat carrier and customer service quality standards, and it shall be foreseen in contract.
84. **Network losses** are at the level of 13% in Poland, on average. Network losses are included into the costs of transportation price, and rule of audited costs for previous reporting year is in place.
85. **Currency risks** are not specifically addressed in Methodology.

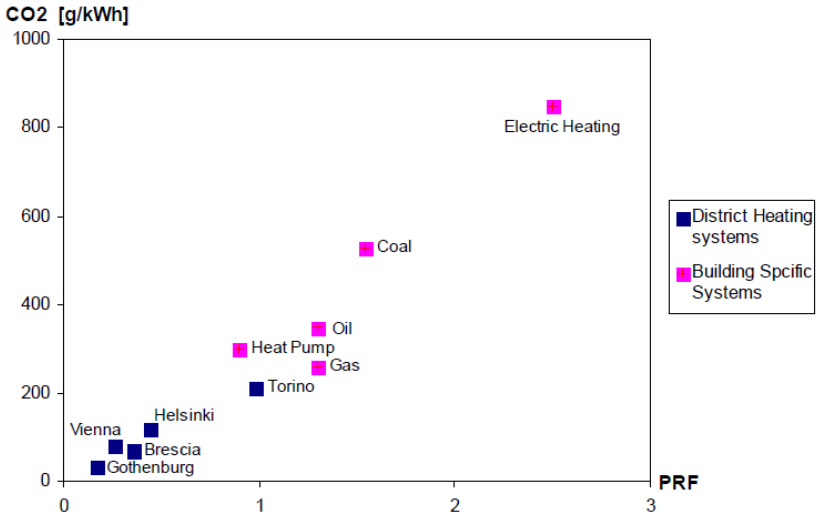
[71] 2 Regulations of the Minister of Economy – in Polish case.

Arbitrary costs as for Incentive based regulation in Czech Republic, by ERU. District Heating

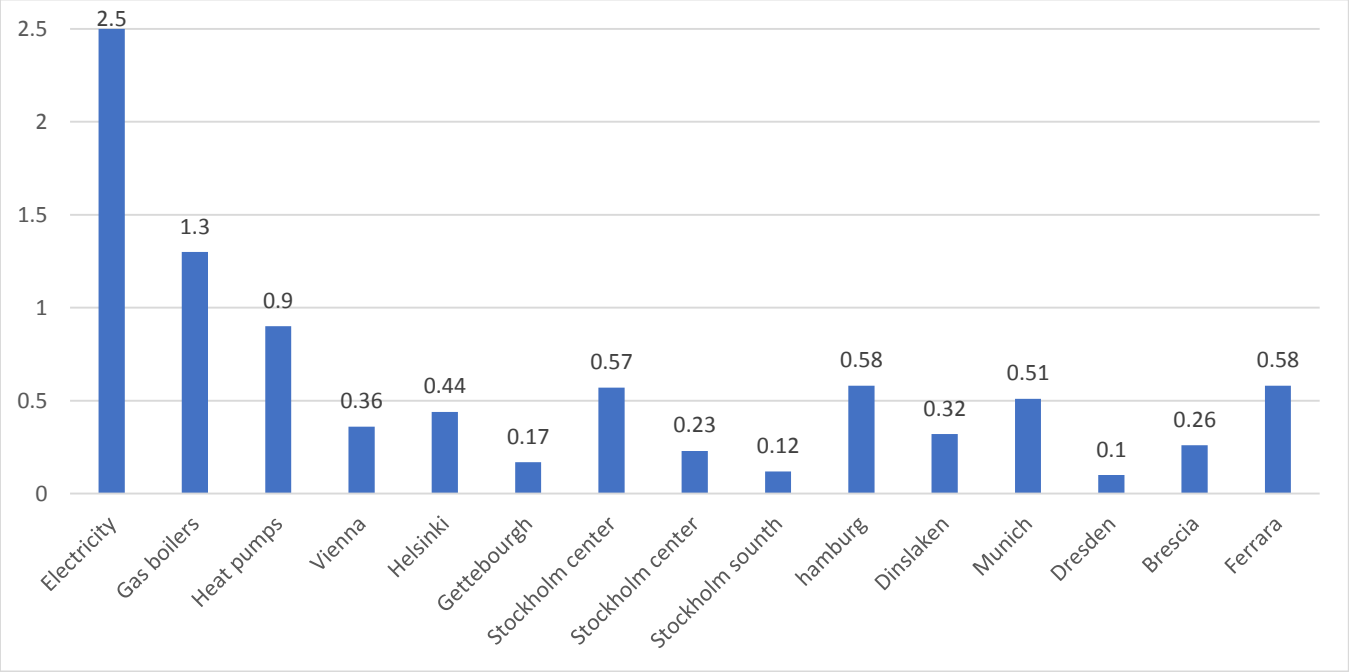
86. **Currency risks** are not specifically addressed in Methodology.
87. **Fines are not eligible** to be recovered by regulated revenue / tariff:
    - "any fees and interest on late payments, fines, sanctions, penalties or surcharges on fees, arising out of contractual relationships or legislation, including environmental";
    - "contributions to the state budget at the failure to comply with requirements to set the health security payments for employees, as provided in the Law on Employment";
    - "the remuneration of the performance of persons who are members of the statutory body or member other corporate bodies";
    - "the payment of premiums for insurance against damage caused by the governing bodies of legal persons".
88. Bad debt and other asset writings-off are not eligible to be recovered by regulated revenue / tariff:
    - "the cost of the writing-off the long-term and short-term assets, and the net book value of these assets, excluding the cost of writing-off of assets, who has lost his operational eligibility."

Annex 1.

Relation between PRF[72] and CO2 of heating systems, as of 2006

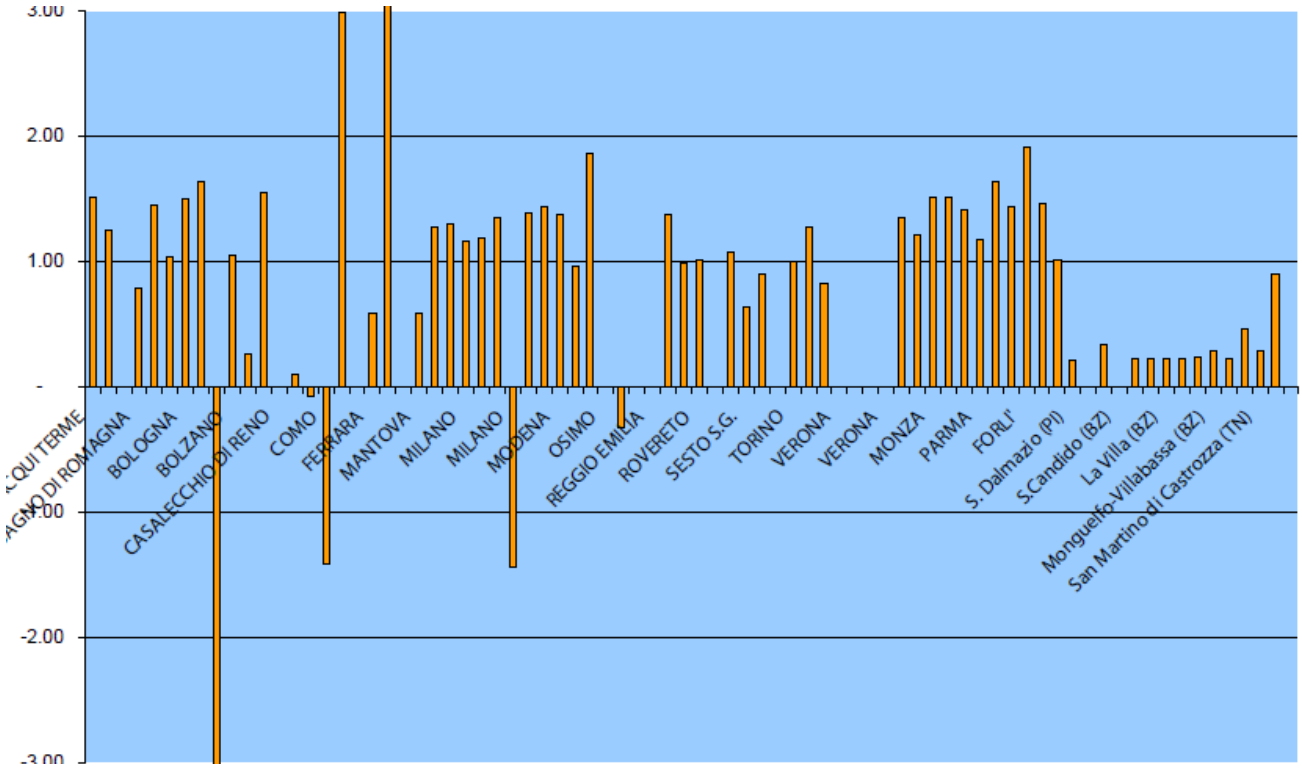


PRF values for different district-heating networks as of 2006

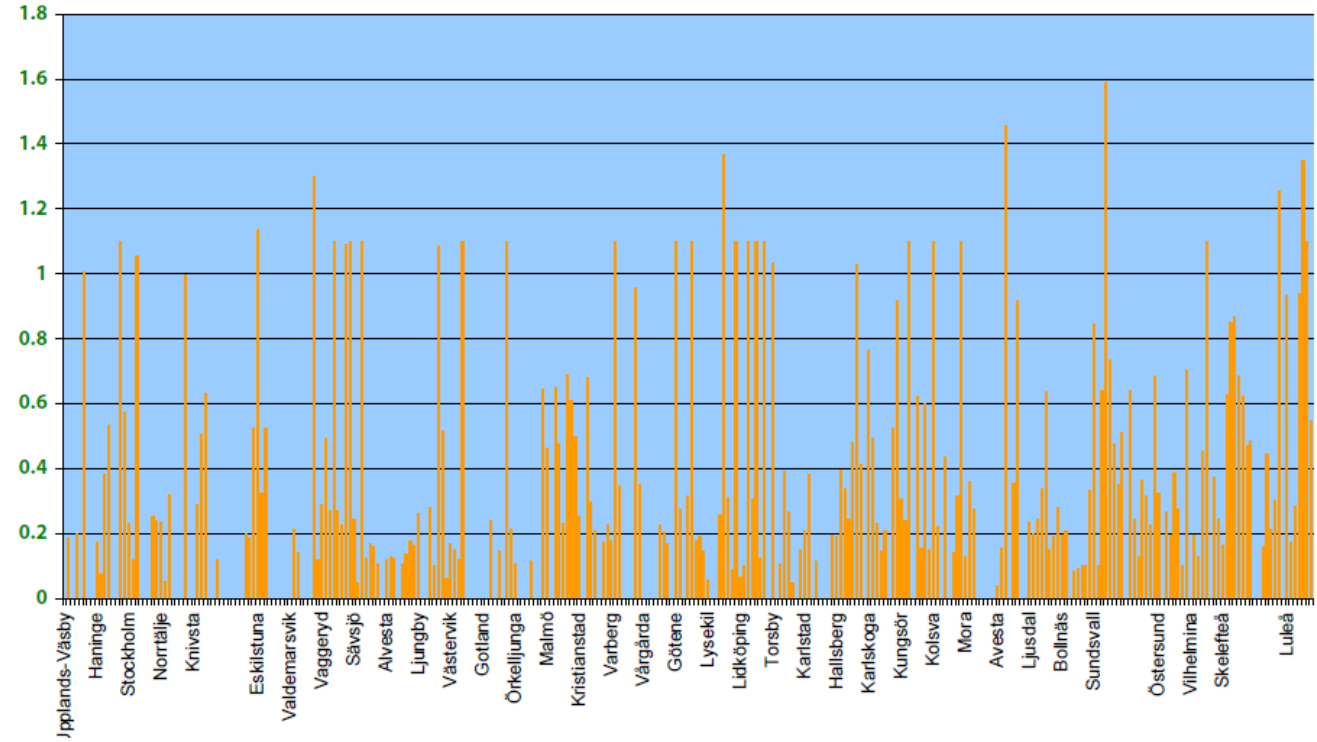


[72] Primary Resource Factor

Primary Resource Factors – Italy



Primary Resource Factors – Italy



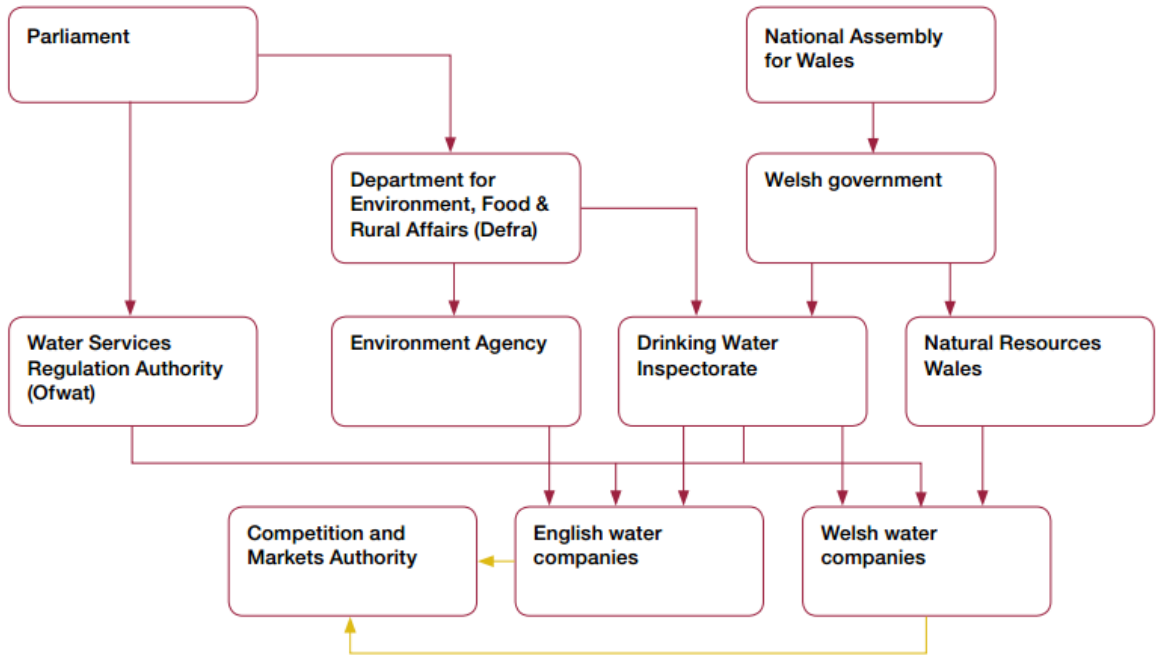
District heating quality indicators for 4 Finnish systems, calculation as of 2009

District Heating Quality Indicator, abbreviation, unit of measure			Inari	Helsinki	Lahti	Juva
Primary energy factor	PEF	-	0.58	0.53	1.00	1.56
Primary energetic efficiency	PEE	-	1.71	0.75	0.69	0.57
Relative importance of losses	RIL	%	11.90	7.96	11.59	19.37
District Heating global efficiency	DHGE	%	87.24	84.90	78.60	71.86
Subscribed Heat Power	SHP	kW/km	766	2546	1146	1174
Equivalent to nominal power duration	H_{eq}	h	2695	1983	1756	1776
CO2 emissions	CO2	TCO2/GWh	119	171	251	437

Annex 2.

Institutional framework of drinking water and sewerage regulation in England and Wales

The framework of water regulation



Notes

1 In addition, Defra and the Welsh government can provide guidance to Ofwat.

2 The Environment Agency also regulates Welsh water companies' operations that are based in England, and Natural Resources Wales regulates English water companies' operations that are based in Wales.

Source: National Audit Office